

(43) International Publication Date  
22 April 2004 (22.04.2004)

PCT

(10) International Publication Number  
WO 2004/033868 A3

(51) International Patent Classification<sup>7</sup>: F01L 9/04, F16K 11/04, 31/08

(21) International Application Number: PCT/US2003/031195

(22) International Filing Date: 1 October 2003 (01.10.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:

60/417,264	9 October 2002 (09.10.2002)	US
60/490,195	25 July 2003 (25.07.2003)	US
10/674,743	29 September 2003 (29.09.2003)	US

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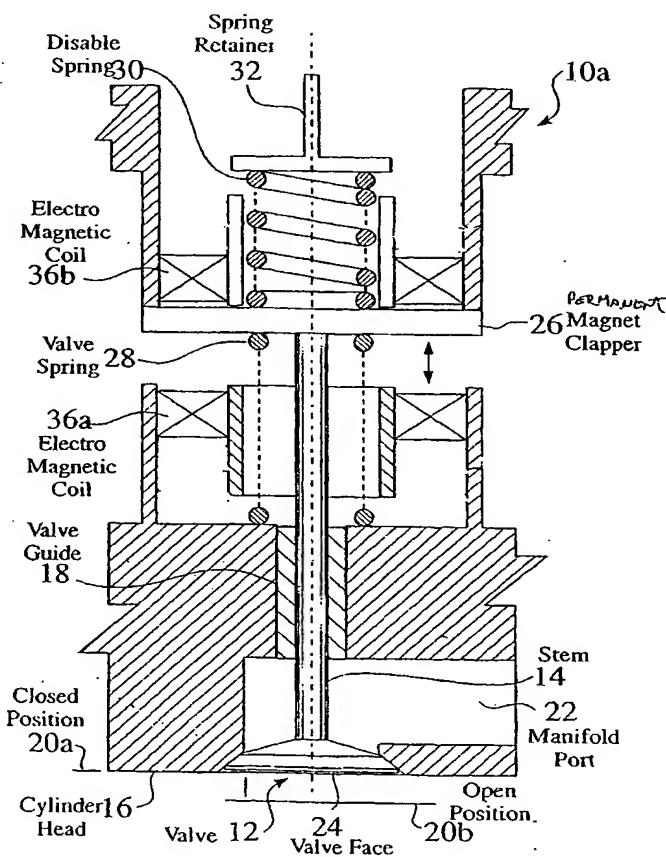
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(81) Designated States (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States (regional): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO,

*[Continued on next page]*

## (54) Title: ELECTROMAGNETIC VALVE SYSTEM



(57) Abstract: Systems (10) are provided for electromagnetic actuation of a valve mechanism. A valve (12) is linearly moveable between a first closed position (20a) and a second open position (20b). A first spring (28) is compressed when the valve is in the first closed position, and a second valve spring (30) is compressed when the valve is in the second open position. An electromagnetic actuation assembly (36a, 36b) and a permanent magnet (26) is combined with the valve, such that the valve is latchable in either a closed or open position, and is readily movable between positions through application of energy to the electromagnetic circuitry. The electromagnetic circuitry is controllable to increase or decrease the local magnetic flux, such as to promote movement of the valve, or to provide a soft landing of the valve at either end of movement. Some system embodiments provide energy recovery, feed back, and/or feed forward sensing and control.

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# INTERNATIONAL SEARCH REPORT

International application No.

PCT/US03/31195

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : F01L 9/04; F16K 11/04, 31/08  
US CL : 251/65, 129.15

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)  
U.S. : 251/65, 129.01-129.22

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)  
East- electromagnetic, permanent, spring, first and second (spring), solenoid

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5,647,311 A (Liang et al) 15 July 1997 (07.15.1997), fig. 4, whole document	23-26,28-33,35,37-39
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Y	US 5,199,392 A (Kreuter et al) 06 April 1993 (06.04.1993), whole document	34, 36,40-41
Y	US 5,494,219 A (Maley et al) 27 February 1996 (27.02.1996), whole document	34, 36, 40-41
A	US 5,769,043 A (Nitkiewicz) 23 June 1998 (23.06.1998), whole document	1
X	US 5,692,463 A (Liang et al) 02 December 1997 (02.12.1997), fig. 1-3, whole document	23-26,28-33,35-37
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Y	US 5,074,259 A (Pusic) 24 December 1991 (24. 12.1991), whole document	34,36,40-41
A	US 6,199,587 B1 (Shlomi et al) 13 March 2001 (12 .03.2001), whole document	1
A	US 6,199,587 B1 (Shlomi et al) 13 March 2001 (12 .03.2001), whole document	1

<input type="checkbox"/>	Further documents are listed in the continuation of Box C.	<input type="checkbox"/>	See patent family annex.
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Date of the actual completion of the international search	Date of mailing of the international search report
22 March 2004 (22.03.2004)	17 MAY 2004
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